

Claims

1. (currently amended) A computer implemented method for detecting components of a non-stationary signal, comprising the steps of:

acquiring the non-stationary signal;
constructing a non-negative matrix of the non-stationary signal, the matrix including columns representing features of the non-stationary signal at different instances in time; and

producing characteristic profiles and temporal profiles of the non-stationary signal by factoring the non-negative matrices ~~factoring the non-negative matrix characteristic profiles and temporal profiles.~~

2. (original) The method of claim 1 in which the non-negative matrix has M temporally ordered columns where M is a total number of histogram bins into which the features are accumulated, such that $M = (L/2+1)$, for a signal of length L .

3. (canceled)

4. (currently amended) The method of claim 2 ~~3~~ in which the non-negative matrix is expressed as $R^{M \times N}$, the temporal profiles are expressed as $R^{M \times R}$ and the characteristic profiles are expressed as $R^{R \times N}$, where $R \leq M$, where R is a number of components to be detected.

5. (original) The method of claim 1 in which the non-stationary signal is an acoustic signal.

6. (original) The method of claim 1 in which the non-stationary signal is a 2D visual signal.

7. (original) The method of claim 1 in which the non-stationary signal is a 3D-scanned signal and frames of the signal represent volumes.

8. (original) The method of claim 4 in which the number of components R is known.

9. (original) The method of claim 4 in which the number of components R is an estimate number of components.

10. (new) The method of claim 1, further comprising:

detecting components in the non-stationary signal according to the characteristic profiles and temporal profiles.

11. (new) The method of claim 1, in which the non-negative matrix is $\mathbf{F} \in \mathbb{R}^{M \times N}$ and the non-negative matrix $\mathbf{F} \in \mathbb{R}^{M \times N}$ is factored into two non-negative matrices $\mathbf{W} \in \mathbb{R}^{M \times R}$ and $\mathbf{H} \in \mathbb{R}^{R \times N}$, where $R \leq M$, such that an error in a non-negative matrix reconstructed from the factors is minimized.

12. (new) The method of claim 8, in which a cost function is

$$C = \|\mathbf{F} - \mathbf{W} \cdot \mathbf{H}\|_F,$$

where $\|\cdot\|_F$ is a Frobenius norm, and C is zero if $\mathbf{F} = \mathbf{W} \cdot \mathbf{H}$.

13. (new) The method of claim 8, in which a cost function is minimized according to

$$D = \left\| \mathbf{F} \otimes \ln \left(\frac{\mathbf{F}}{\mathbf{W} \cdot \mathbf{H}} \right) - \mathbf{F} + \mathbf{W} \cdot \mathbf{H} \right\|_F,$$

where \otimes is a Hadamard product, and D is zero if $\mathbf{F} = \mathbf{W} \cdot \mathbf{H}$.

14. (new) The method of claim 10, in which the non-stationary signal is music and the components are notes.

15. (new) The method of claim 10, in which the non-stationary signal is visual and the components are spatial features in frames of the video.

16. (new) The method of claim 1, in which the non-stationary signal includes an acoustic signal and a visual signal acquired simultaneously.

17. A system for detecting components of a non-stationary signal, comprising:

- a sensor;
- an analog-to-digital converter;
- a sample buffer;
- a transform;
- a matrix buffer; and

a factorer serially connected to each other, in which an acquired non-stationary signal is input to the analog-to-digital converter to output samples to the sample buffer, in which the samples are windowed to produce frames for the transform, which outputs features to the matrix buffer as a non-negative matrix, which is factored to produce characteristic profiles and temporal profiles.

18. (new) A system for detecting components of a non-stationary signal, comprising:

- acquiring an acoustic signal;
- sampling the acoustic signal to produce to produce samples;
- windowing the samples to produce frames;
- transforming the frame to produce the features;
- constructing a non-negative matrix from the features;
- producing characteristic profiles and the temporal profiles by factoring the non-negative matrix.